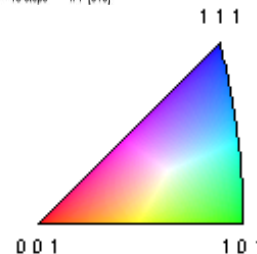
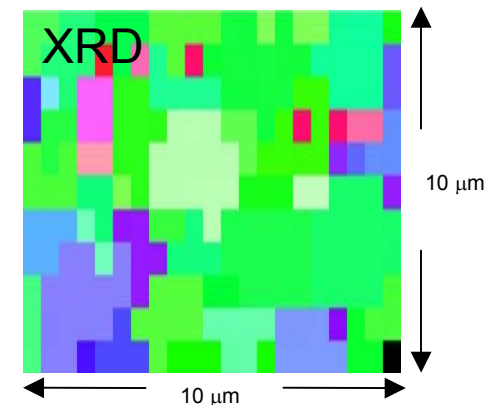
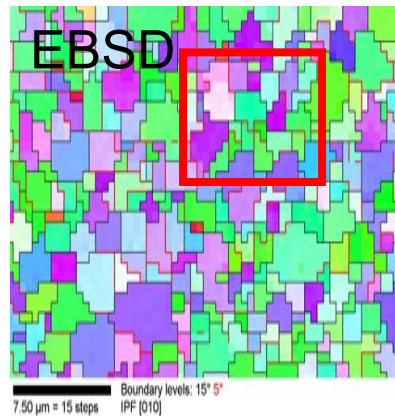
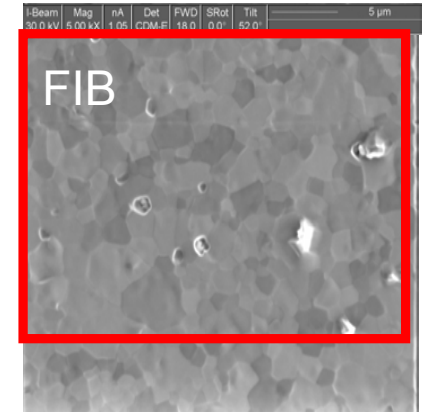
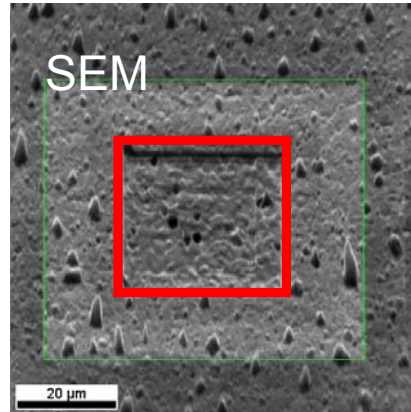


Grain Structure Mapping for Studies of Strain in Polycrystalline Thin Films

G. S. Cargill III, Lehigh University, DMR-0312189

Scanning electron microscopy (SEM), focused ion beam (FIB) imaging, electron back scatter diffraction (EBSD) mapping, and microbeam x-ray diffraction (XRD) are being widely applied to polycrystalline films. A recent study using FIB, SEM and EBSD at Lehigh University and synchrotron microbeam XRD at the Advanced Photon Source illustrates the synergy of this multi-technique approach for studies of thermal strains in polycrystalline aluminum thin films.

Extrusions, or “hillocks,” produced by compressive thermal stresses are clearly seen in the SEM image. The indicated region from the SEM image is shown in the higher magnification FIB image, where differently oriented grains are different shades of gray. EBSD images of the indicated area from the FIB image give individual in-plane grain orientations, but with spatial resolution, $\sim 0.5\mu\text{m}$, that is poorer than with SEM or FIB, $< 0.1\mu\text{m}$. Microbeam XRD maps of the indicated smaller region in the EBSD image provide grain orientation and strain information (not shown) with $\sim 0.5\mu\text{m}$ spatial resolution.



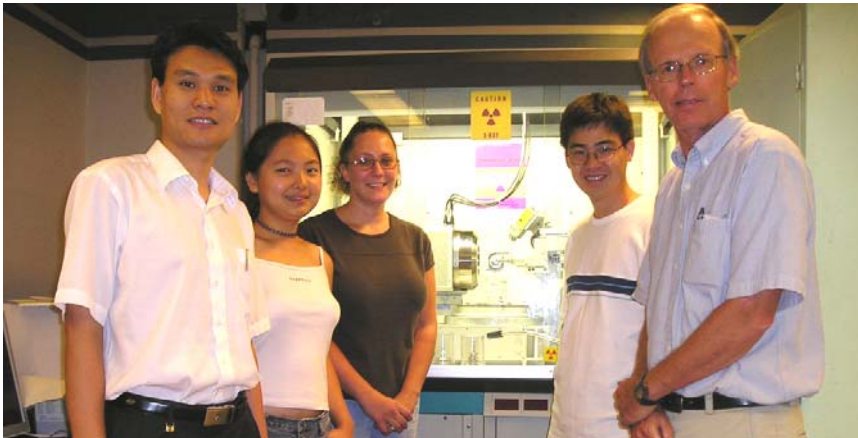
Images and in-plane grain orientation maps for 1 μm thick evaporated Al film on Si substrate.

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Broader Impacts:

These experiments were carried out by Lehigh graduate students Laura Moyer and Gan Wang. During summer '04 Mr. Wang also participated in a Southeastern Univ. Research Assoc. sponsored project with Dr. B. C. Larson at ORNL, and he attended a two-week diffraction summer school at ANL. In Fall '04, Hongquing Zhang joined the group as a new graduate student, and Jen Deng joined the group as an undergraduate work study student.



Dr. Cargill (far right) with students (from left) Hongquing Zhang, Jen Deng, Laura Moyer, and Gan Wang.

Another Lehigh undergraduate, Matt Kampner, was a REU student on this project during summer '03. He spent last summer in Professor T. Mizoguchi's research group at Gakushuin University, Tokyo, Japan.



Matt Kampner (lower left) in Japan with Professor Mizoguchi's research group during summer '04.